Amendments to the Drawings

Enclosed with this Amendment and Response are two sheets of proposed substitute drawings (Sheets 1/49 and 6/49) containing Figs. 1a to 1d and Fig. 6 respectively. Applicants respectfully request that the two sheets of substitute drawings submitted herewith be substituted for the two corresponding sheets of originally-filed drawings.

This proposed drawing amendment is offered in response to the Examiner's drawing objections in paragraphs 1-3 of the Office Action. This proposed drawing amendment only affects Sheets 1/49 and 6/49, and it does not affect any of the other sheets of originally filed drawings.

1. New Sheet 1/49

Proposed new Sheet 1/49 is identical to original Sheet 1/49 except in new Sheet 1/49 the caption "Fig. 1" has been deleted from under the four drawings appearing on this sheet. This corrects an obvious typographical error on this sheet of drawings. This modification is believed to obviate the Examiner's objection to this sheet of drawing.

2. New Sheet 6/49

Proposed new Sheet 6/49 is identical to original Sheet 6/49 except in new Sheet 6/49 the captions "Fig. 14a" and "Fig. 14b" have been deleted. This corrects an obvious typographical error on this sheet of drawings. This modification is believed to obviate the Examiner's objection to this sheet of drawing.

The Examiner's comments about possible ambiguities related to Fig. 2, Fig. 4 and Fig. 14 appear to be based on the typographical errors on original Sheets 1/49 and 6/49. Accordingly, these issues are also believed to be addressed by the proposed revisions to Sheets 1/49 and 6/49 as discussed above.

REMARKS

A. Status of the Claims / Amendments to the Specification, Claims and Drawings

In the Office Action of May 13, 2008, the status of the claims was as follows:

Claims 43, 44, 49, 52 and 56-61 were rejected under 35 U.S.C. §112.

Claims 37, 38, 40, 41-45, 47, 48, 56-58, 60, 62 and 63 were rejected under 35 U.S.C. §102(b).

Claims 39, 46, 49-55, 59 and 61 were rejected under 35 U.S.C. §103(a).

In addition, the Examiner raised objections to the Drawings and the Specification.

The objections to the Drawings and the Specification are believed to be addressed herein by the proposed amendments to the Drawings and by the amendment to the Specification, as discussed further below.

All of the previously pending claims (Claims 37-63) have been canceled by this Amendment. New Claims 64-74 have been added. No new matter has been added. New Claims 64-74 focus on a particular embodiment of the present invention that is fully supported by the original disclosure. For example, the subject matter of new independent Claim 64 is based on the Examples in the Specification, e.g., Example 10 at pages 26-27. New dependent Claims 65-74 correspond generally to previously pending dependent claims as follows: 65 (39); 66 (47 + 56); 67 (48); 68 (50); 69 (57); 70 (58); 71 (58); 72 (58); 73 (62); and 74 (63).

B. Drawing Objections

As discussed above, Applicants have submitted herewith for the Examiner's approval two sheets of proposed corrected drawings (Sheets 1/49 and 6/49) to correct minor and

obvious typographical errors on original Sheets 1/49 and 6/49. Substitution of the new Sheets 1/49 and 6/49 for the corresponding original sheets is respectfully requested.

C. Specification Objections

The Examiner objected to the Specification because it did not include a brief description of the drawings. This Amendment adds a "Brief Description of the Drawings" section to the application. The descriptions of the various Figures in the "Brief Description of the Drawings" are taken directly from the references to these Figures as they appear in the original disclosure. Accordingly, no new matter has been added. Applicants respectfully submit that this Amendment obviates the objection to the Specification.

D. Section 112 Rejections

Each of the claims included in the Sec. 112 rejections has herein been canceled. Applicants respectfully submit that new Claims 64-74 submitted herewith fully meet the requirements of 35 U.S.C. §112.

E. Sec. 102(b) Rejections – Thompson '814

Claims 37, 38, 40, 41-45, 47, 48, 56-58, 60, 62 and 63 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Pat. No. 6,210,814 (Thompson '814). All of these claims have now been canceled. Applicants respectfully submit that new Claims 64-74 clearly distinguish over Thompson '814.

New independent Claim 64 is directed to an electroluminescent device comprising first and second electrodes with a layer of an electroluminescent composition between the

electrodes. Claim 64 defines the electroluminescent composition as "a metal quinolate selected from zirconium quinolate and hafnium quinolate doped with 10^{-3} to 10 mole % of a fluorescent dopant...."

Thompson '814 does not teach the electroluminescent device as claimed in new Claim 64. Instead, Thompson '814 teaches a three-component electroluminescent layer consisting of: (1) a host material; (2) an "emissive molecule;" and (3) a "polarization molecule ... having a dipole moment, that affects the wavelength of the light emitted when said emissive dopant molecule luminesces...." Thompson '814 is principally directed to embodiments wherein aluminum quinolate is the "host material." Thompson '814 generally teaches that other types of "quinoline-based materials" may be used as the "host material," but this reference does not teach or suggest that particular benefits can be realized by the use of zirconium or hafnium quinolate as the host material in the electroluminescent layer.

The present application clearly demonstrates that using zirconium quinolate as the host material instead of aluminum quinolate in the electroluminescent devices of this invention unexpectedly leads to surprisingly improved performance characteristics. Thus, Example 10 at pages 26-27 of this application directly compares the use of zirconium and aluminum quinolates in electroluminescent compositions for electroluminescent devices. Table 1 at page 27 shows the following comparative data:

(1) The electroluminescent composition using Zrq_4 demonstrated a 40% greater luminescence efficiency (7 versus 5) as compared with an identical composition using Alq_3.

(2) The electroluminescent composition using Zrq_4 demonstrated a 36% greater luminescence efficiency (1500 versus 1100) as compared with an identical composition using Alq_3.

(3) The electroluminescent composition using Zrq_4 demonstrated a 14% lower turn-on voltage (6 versus 7) as compared with an identical composition using Alq_3.

None of these special and advantageous properties of zirconium quinolate and hafnium quinolate relative to aluminum quinolate when used in an electroluminescent composition are taught or suggested by Thompson '814 or any other prior art in this field.

This application is based in part on the surprising discovery that certain properties of zirconium and hafnium quinolates result in unexpectedly superior performance characteristics when these materials are used in an electroluminescent composition according to this invention. For example, compared with aluminum quinolate as a host material, zirconium quinolate and hafnium quinolate have been found to have higher electron mobilities. This property allows an electroluminescent device having an electroluminescent composition including zirconium quinolate or hafnium quinolate to operate at a lower voltage than a comparable electroluminescent device in which aluminum quinolate is used in the electroluminescent composition. This advantage is neither taught nor suggested by Thompson '814.

Furthermore, Applicants have found that zirconium quinolate and hafnium quinolate have substantially no effective dipole moment. As a result, the color produced under excitation conditions by an electroluminescent composition consisting essentially of zirconium quinolate or hafnium quinolate together with an emissive dopant is substantially purely the color of the emissive dopant being used without a color contribution or distortion caused by the metal quinolate host material. By contrast, using aluminum quinolate in a similar electroluminescent composition causes noticeable dilution and/or distortion of the dopant color under excitation conditions.

It is with respect to such dipole moment comparisons that the distinctions between Thompson '814 and the presently claimed invention become most apparent. Whereas the invention as presently claimed is directed to an electroluminescent composition that, under excitation conditions, produces a substantially pure, undistorted color emission based on the color of the dopant, Thompson '814 by contrast is specifically directed to an electroluminescent composition wherein "the wavelength of light emitted by the emissive layer may be tuned by varying the concentration of polar dopant molecules in the emissive layer," (Thompson '814 at col. 1, lines 10-14). Thus, the object of Thompson '814 is to modify the color of the emissions produced by the emissive dopant.

Whereas the present invention is directed to minimizing emissive color distortions by minimizing the dipole moment of the electroluminescent composition, by contrast Thompson '814 states (col. 8, lines 1-4) that: "It is therefore preferable, that the emissive dopant molecule has a dipole moment above about 5 debyes, more preferably above about 7 debyes, and most preferably above about 10 debyes." The subsequent paragraph of Thompson '814 (at col. 8, lines 5-12) discusses in detail how to cause "a shift in the spectral emission of OLEDs having an emissive layer of ... Alq_3 doped with DCM2, by changing the concentration of DCM2...."

The very next paragraph of Thompson '814 (at col. 8, lines 22-36) describes how a "polarization dopant molecule, i.e., a molecule that contributes to the local dipole moment, separate from the emissive dopant molecule, may be used ... to increase the local dipole moment of the host without increasing the concentration of the emissive dopant molecule.... Preferably, the polarization dopant molecule has a high dipole moment [which] allows the local dipole moment of the host to be changed using only small concentrations of the

polarized dopant molecule." Thus, the entire thrust of Thompson '814 is to increase, NOT to minimize, the dipole moment of the electroluminescent composition.

At col. 21, lines 33-34, Thompson' 814 teaches that: "One host material used in OLEDs is Alq_3 [which has] a dipole moment of approximately 5D.... [Thus, in] order for a polar dopant to affect the polarity of the medium it must have a volume dipole moment larger than Alq_3." In view of these considerations, Thompson '814 teaches that it might sometimes be advantageous to use a "nonpolar" (or less polar) matrix (col. 21 at lines 42-44). But, the only reason for doing so in Thompson '814 is to make the electroluminescent layer more responsive to the dipole moment increasing effect of adding a polarization dopant molecule. Thompson '814 absolutely does not envision the use of a "nonpolar" or "less polar" host material without also adding both an emissive dopant and a polarization dopant molecule.

For all of these reasons, Applicants respectfully submit that new Claims 64-74 are not anticipated by, or obvious in view of, the Thompson '814 patent.

F. **Sec. 103(a) Rejection – Thompson '814 / Hirai '962**

Claims 39, 46, 49-51, 53, 54 and 61 were rejected under 35 U.S.C. §103(a) as being unpatentable over Thompson '814 in view of U.S. Pat. Publ. No. US 2001/0028962 (Hirai '962). All of these claims have now been canceled. Applicants respectfully submit that new Claims 64-74 clearly distinguish over Thompson '814 and Hirai '962 whether these references are taken individually or in combination.

In paragraph 11 of the Office Action, the Examiner acknowledged that there are a number of deficiencies in Thompson '814 relative to the rejected claims. It was these deficiencies in Thompson '814 that necessitated the citation of Hirai '962 as a secondary

reference to support this Sec. 103(a) rejection. Hirai '962, however, does not remedy the fundamental deficiencies of Thompson '814, as discussed in part E above, relative to new Claims 64-74.

As discussed above, Thompson '814 does not teach or suggest electroluminescent devices having an electroluminescent layer consisting essentially of zirconium quinolate or hafnium quinolate as a host material and an emissive dopant. Thompson '814 also fails to teach or suggest that an electroluminescent device incorporating an electroluminescent layer that includes zirconium quinolate or hafnium quinolate demonstrates unexpectedly superior performance characteristics in comparison with a comparable electroluminescent device using aluminum quinolate in the electroluminescent layer. Similarly, Hirai '962 does not teach or suggest electroluminescent devices having an electroluminescent layer consisting essentially of zirconium quinolate or hafnium quinolate as a host material and an emissive dopant, nor does Hirai '962 teach or suggest the superior performance characteristics obtained by using zirconium quinolate or hafnium quinolate.

The Hirai' 962 reference is also directed to a different type of electroluminescent device having a different objective than the electroluminescent device of Thompson '814. Hirai '962 is particularly directed to a color-converting film comprising a light-transmittable substrate and a color-converting layer containing an orthometallation complex for fluorescence conversion. This is a very different intended use than the electroluminescent device of Thompson '814. It is well recognized in the chemical arts in general, and particularly in the newly-emerging LED field, that different chemicals perform/interact differently in different environments, under different physical conditions, and in the presence of other chemical substances.

Thus, the fact that the devices of Thompson '814 and Hirai '962 might broadly be characterized as "electroluminescent devices" does not automatically mean that there is a simple interchangeability of structures and active chemical components. The Examiner here has provided no reasoning or teaching reference to support the argument that it would be "obvious" to substitute or combine selected elements taken from Hirai '962 with other, different elements of Thompson '814 in the manner urged in this rejection.

For all of these reasons, Applicants respectfully submit that new Claims 64-74 are not obvious in view of the Thompson '814 and Hirai '962 references.

G. Sec. 103(a) Rejection – Thompson '814 / Marrocco '347

Claim 55 was rejected under 35 U.S.C. §103(a) as being unpatentable over Thompson '814 in view of U.S. Pat. Publ. No. US 2002/0028347 (Marrocco '347). Claim 55 has now been canceled. Applicants respectfully submit that new Claims 64-74 clearly distinguish over Thompson '814 and Marrocco '347 whether these references are taken individually or in combination.

In paragraph 12 of the Office Action, the Examiner acknowledged that Thompson '814 "does not explicitly disclose wherein the electroluminescent composition is mixed with an effective amount of the hole transmitting material." It was this deficiency in Thompson '814 that necessitated the citation of Marrocco '347 as a secondary reference to support this Sec. 103(a) rejection. Marrocco '347, however, does not remedy the fundamental deficiencies of Thompson '814, as discussed in part E above, relative to new Claims 64-74.

As discussed above, Thompson '814 does not teach or suggest electroluminescent devices having an electroluminescent layer consisting essentially of zirconium quinolate or

hafnium quinolate as a host material and an emissive dopant. Thompson '814 also fails to teach or suggest that an electroluminescent device incorporating an electroluminescent layer that includes zirconium quinolate or hafnium quinolate demonstrates unexpectedly superior performance characteristics in comparison with a comparable electroluminescent device using aluminum quinolate in the electroluminescent layer. Similarly, Marrocco '347 does not teach or suggest electroluminescent devices having an electroluminescent layer consisting essentially of zirconium quinolate or hafnium quinolate as a host material and an emissive dopant, nor does Marrocco '347 teach or suggest the superior performance characteristics obtained by using zirconium quinolate or hafnium quinolate.

Also as discussed above, the Examiner here has provided no reasoning or teaching reference to support the argument that it would be "obvious" to substitute or combine selected elements taken from Marrocco '347 with other, different elements of Thompson '814 in the manner urged in this rejection.

For all of these reasons, Applicants respectfully submit that new Claims 64-74 are not obvious in view of the Thompson '814 and Marrocco '347 references.

H. Sec. 103(a) Rejection - Thompson '814 / Hong et al.

Claim 59 was rejected under 35 U.S.C. §103(a) as being unpatentable over Thompson '814 in view of Hong et al. Claim 59 has now been canceled. Applicants respectfully submit that new Claims 64-74 clearly distinguish over Thompson '814 and Hong et al. whether these references are taken individually or in combination.

In paragraph 13 of the Office Action, the Examiner acknowledged that Thompson '814 "does not explicitly disclose a compound with the general chemical formula $Mx(DBM)_n$

as an electron transporting material." It was this deficiency in Thompson '814 that necessitated the citation of Hong et al. as a secondary reference to support this Sec. 103(a) rejection. Hong et al., however, does not remedy the fundamental deficiencies of Thompson '814, as discussed in part E above, relative to new Claims 64-74.

As discussed above, Thompson '814 does not teach or suggest electroluminescent devices having an electroluminescent layer consisting essentially of zirconium quinolate or hafnium quinolate as a host material and an emissive dopant. Thompson '814 also fails to teach or suggest that an electroluminescent device incorporating an electroluminescent layer that includes zirconium quinolate or hafnium quinolate demonstrates unexpectedly superior performance characteristics in comparison with a comparable electroluminescent device using aluminum quinolate in the electroluminescent layer. Similarly, Hong et al. does not teach or suggest electroluminescent devices having an electroluminescent layer consisting essentially of zirconium quinolate or hafnium quinolate as a host material and an emissive dopant, nor does Hong et al. teach or suggest the superior performance characteristics obtained by using zirconium quinolate or hafnium quinolate.

Also as discussed above, the Examiner here has provided no reasoning or teaching reference to support the argument that it would be "obvious" to substitute or combine selected elements taken from Hong et al. with other, different elements of Thompson '814 in the manner urged in this rejection.

For all of these reasons, Applicants respectfully submit that new Claims 64-74 are not obvious in view of the Thompson '814 and Hong et al. references.

I. Sec. 103(a) Rejection - Thompson '814 / Yang '873

Claim 52 was rejected under 35 U.S.C. §103(a) as being unpatentable over Thompson '814 in view of U.S. Pat. No. 5,723,873 (Yang '873). Claim 52 has now been canceled. Applicants respectfully submit that new Claims 64-74 clearly distinguish over Thompson '814 and Yang '873 whether these references are taken individually or in combination.

In paragraph 14 of the Office Action, the Examiner acknowledged that Thompson '814 "does not explicitly disclose wherein the hole transporting material is a polymer of aniline with copolymers of o-toluidine or o-ethylaniline." It was this deficiency in Thompson '814 that necessitated the citation of Yang '873 as a secondary reference to support this Sec. 103(a) rejection. Yang '873, however, does not remedy the fundamental deficiencies of Thompson '814, as discussed in part E above, relative to new Claims 64-74.

As discussed above, Thompson '814 does not teach or suggest electroluminescent devices having an electroluminescent layer consisting essentially of zirconium quinolate or hafnium quinolate as a host material and an emissive dopant. Thompson '814 also fails to teach or suggest that an electroluminescent device incorporating an electroluminescent layer that includes zirconium quinolate or hafnium quinolate demonstrates unexpectedly superior performance characteristics in comparison with a comparable electroluminescent device using aluminum quinolate in the electroluminescent layer. Similarly, Yang '873 does not teach or suggest electroluminescent devices having an electroluminescent layer consisting essentially of zirconium quinolate or hafnium quinolate as a host material and an emissive dopant, nor does Yang '873 teach or suggest the superior performance characteristics obtained by using zirconium quinolate or hafnium quinolate.

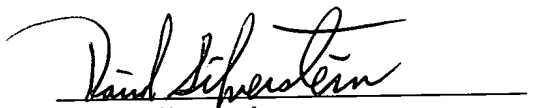
Also as discussed above, the Examiner here has provided no reasoning or teaching reference to support the argument that it would be "obvious" to substitute or combine selected elements taken from Yang '873 with other, different elements of Thompson '814 in the manner urged in this rejection.

For all of these reasons, Applicants respectfully submit that new Claims 64-74 are not obvious in view of the Thompson '814 and Yang '873 references.

SUMMARY AND CONCLUSIONS

For all of the foregoing reasons, Claims 64-74 are in condition for allowance and an early notice thereof is earnestly requested.

Respectfully submitted,



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